Empirical Estimates of Adaptation Costs and Benefits

Key Insights and Limitations

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OECD Work on Economic Aspects of Adaptation

Key Pillars

- *Empirical Estimates* of Adaptation Costs and Benefits
- *Policy Instruments* for Incentivising Adaptation
- Role of *Insurance* in Climate Change Adaptation
- *Joint Simulation of Adaptation and Mitigation Costs* Using Integrated Assessment Models

1. SECTORAL ESTIMATES

Sector	Regional Coverage	Cost Estimates	Benefit Estimates
Coastal Zones	Global comprehensive	√	√
Agriculture	Global comprehensive	–	√
Water	Isolated case studies	√	√
Energy (Demand)	Primarily N. America	√	√
Infrastructure	Isolated example s(e.g. Water, e.g. Coastal zones)	√	–
Health	Limited coverage	√	–
Tourism	Winter tourism	√	–

1.1 COASTAL ZONES

Regions/Countries		Reference	Sea Level Rise Considered	Protection Level (% of coastline protected, unless noted)	Protection costs (Billion USD)	% GDP or GNP
WORLD	Global	Nicholls (2007)[1]	8.9–9.1cm by 2030 (average); max 44.4–52.7cm by 2080	Not available (n/a)	4014-10664	Not available (n/a)
		Tol (2002)	1m	89 %[8]	1055	n/a
		Mendelsohn et al (2000)	0.5m	n/a	10 (1990 USD)	n/a
		Nordhaus&Boyer (2000)	+2.5°C	n/a	n/a	0.32 % of 2100 GDP
		Tol et al (1998)	1m	88 %[2]	n/a	0.056 %GNP[b] (average)
EUROPE AND FORMER SOVIET UNION	OECD Europe	Nicholls (2007)[1]	8.9–9.1cm by 2030 (average); max 44.4–52.7cm by 2080	n/a	0.624-1.785	n/a
	OECD-Europe CEE-fSU	Tol (2002)	1m	86 % 93 %	136 53	n/a
	Western Europe	Deke et al (2001)	1m	Total	176	0.02 %GDP[b]
	EU EE & fSU	Bosello et al (2007)	25cm (by 2050)	Total	11.2 23.07	0.02 %GDP[a] 0.33 %GDP[a]
	N. & W. Europe Baltic States N. Mediterranean fSU	Tol et al (1998)	1m	0[2] 0[2] 16 %[2] 0[2]	n/a	0.02 %GNP[b] 0.08 %GNP[b] 0.02 %GNP[b] 0.02 %GNP[b]
	The Netherlands Poland	Tol et al (1998)	1m	95 %[2]	n/a	0.05 %GNP[b] 0.02 %GNP[b]
N. & C. AMERICA, CARRIBEAN	OECD N. America	Nicholls (2007)[1]	8.9–9.1cm by 2030 (average); max 44.4–52.7cm by 2080	n/a	0.882-2.022	n/a
	OECD - America	Tol (2002)	1m	77 %	83	n/a
	N. America	Deke et al (2001)	1m	Total	59	0.02 %GDP[b]
	N. America Central America	Tol et al (1998)	1m	47 %[2] 89 %[2]	n/a	0.02 %GNP[b] 0.23 %GNP[b]
	USA	Bosello et al (2007)	25cm (by 2050)	Total	511	0.01 %GDP[a]
	Antigua	Tol et al (1998)	1m	59 %[2]	n/a	0.32 %GNP[b]
SOUTH (SA)/ LATIN AMERICA	Latin America	Nicholls (2007)[1]	8.9–9.1cm by 2030 (average); max 44.4–52.7cm by 2080	n/a	0.573-1.597	n/a
	Latin America	Tol (2002)	1m	86 %	147	n/a
	Latin America	Deke et al (2001)	1m	Total	13.3	0.01 %GDP[b]
	SA Atlantic Coast	Tol et al (1998)	1m	88 %[2]	n/a	0.25 %GNP[b]
	SA Pacific Coast			89 %[2]		0.01 %GNP[b]
	Guyana	Nicholls & Tol (2006)	20-35cm by 2080s	n/a	n/a	0.1-0.4 %GDP[7]

Regions/Countries		Reference	Sea Level Rise Considered	Protection Level (% of coastline protected unless noted)	Protection costs (Billion USD)	% GDP or GNP
ASIA	Developing Asia	Nicholls (2007)[1]	8.9–9.1cm by 2030 (average); max 44.4–52.7cm by 2080	n/a	0.801-2.181	n/a
	S. & SE Asia	Tol (2002)	1m	93 %	305	n/a
	CPA			93 %	171	
	SE Asia	Tol et al (1998)	1m	89 %[2]	n/a	**0.2 %GNP[6]**
	East Asia			87 %[2]		**0.06 %GNP[5]**
	Asia Indian Ocean Coast			89 %[2]		**0.52 %GNP[6]**
	Indian Ocean Small Islands			88 %[2]		**0.72 %GNP[6]**
	Pacific Asia	Deke et al (2001)	1m	Total	208	**0.05 %GDP[5]**
	OECD				156	**0.19 %GDP[5]**
	Pacific Asia				78	**0.2 %GDP[5]**
	China				56.5	**0.25 %GDP[5]**
	India					
	Japan	Bosello et al (2007)	25cm (by 2050)	Total	7.6	**0.03 %GDP[4]**
	China and India				11.7	**0.11 %GDP[4]**
	Maldives	Nicholls & Tol (2006)	20-35cm by 2080s	n/a	n/a	**0-0.2 %GDP[7]**
	Vietnam					**0-0.2 %GDP[7]**
	Cambodia					**0-0.1 %GDP[7]**
	Taiwan	Shaw et al (2000)	0.5m	9 %	35.7 billion NT$	n/a
	Singapore	Ng & Mendelsohn (2005)	0.2 and 0.86m by 2100	Total	NPV in 2000 USD: 0.17-3.08 million/yr (0.2-0.87m rise)	n/a
PACIFIC	OECD Pacific	Nicholls (2007)[1]	8.9–9.1cm by 2030 (average); max 44.4–52.7cm by 2080	n/a	0.388-1.080	n/a
	OECD - Pacific	Tol (2002)	1m	95 %	63	n/a
	Pacific Ocean Large Island	Tol et al (1998)	1m	76 %[2]	n/a	**0.17 %GNP[6]**
	Pacific Ocean Small Island			88 %[2]		**0.77 %GNP[6]**
	Marshall Island			90 %[2]		**>7.04 %GNP[6]**
	Micronesia	Nicholls & Tol (2006)	20-35cm by 2080s	85-99 %	n/a	**5-13.5 %GDP[7]**
	Palau			65-95 %		**3.9- 9.1 %GDP[7]**
	Tuvalu			75-98 %		**0.9-2.2 %GDP[7]**
	Marshall Islands			n/a		**0.6-1.7 %GDP[7]**
	F. Polynesia			83-99 %		**0.4-1.0 %GDP[7]**
	Nauru			n/a		**0.2-0.6 %GDP[7]**
	New Caledonia			43-93 %		**0.2-0.4 %GDP[7]**
	Papua New Guinea			75-98 %		**0.2-0.4 %GDP[7]**
	Kiribati			0.75 %		**0.1-2 %GDP[7]**

1.1 COASTAL ZONES

- "Optimal"levels of costal protection generally quite high, if not total for most regions; cost estimates low in % national GDP terms

- There are however substantial regional differences, and absolute costs can be significantly high

- Consider only a narrow set of impacts and adaptation measures

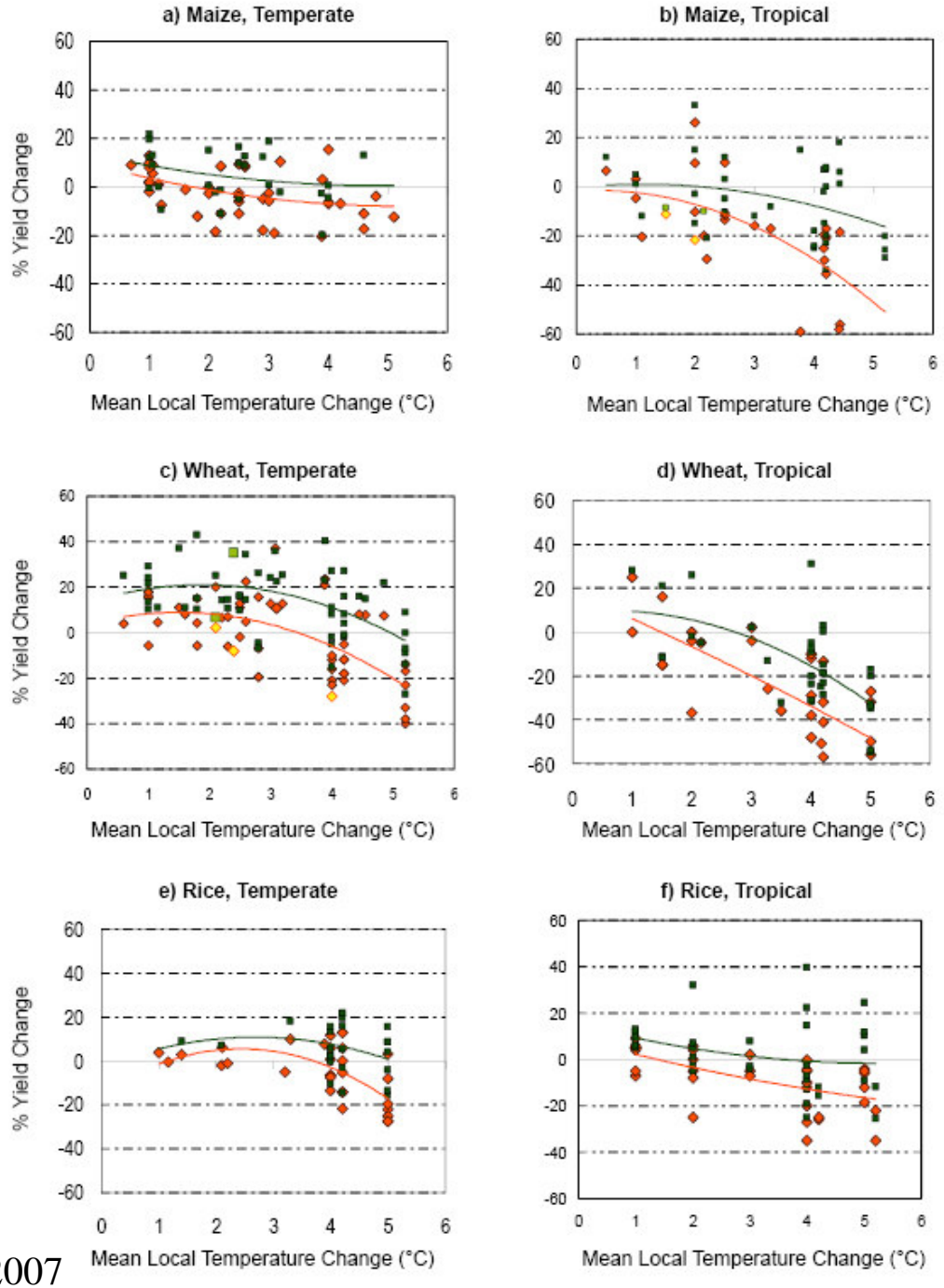
- Highly sensitive to assumptions about extrapolated protection costs, as well as to values of endowments at risk

- Generally do not reflect dynamic market realties

- Generally do not consider macro-economic effects of loss of valuable endowments, as well as of investments in protective structures

1.2 AGRICULTURE

- Relatively modest adaptations can significantly offset declines in projected yields
- Benefits, however, do not translate equally to all regions, crops, and levels of climate change
- Studies often do not explicitly consider financial and institutional constraints which might limit the realisation of these benefits
- Costs of adaptation generally not considered. One recent assessment concludes that cost of public investment in research, extension, and physical capital for agriculture could be fairly substantial(billions of $/year)



Easterling et al 2007

1.3 OTHER SECTORS

- **Water**: Regions where rainfall will increase flood protection, waste-water treatment will dominate adaptation costs. Investments in storage, meanwhile, will comprise bulk of adaptation costs where rainfall (also glacier melt) is projected to decline

- **Energy**: Limited focus on increase in energy demand. Costs of increased cooling expected to exceed benefits from reduced heating.

- **Infrastructure:** Key component of adaptation costs, cut across multiple sectors (coasts, agriculture, water…).

- **Health**: Hard to delineate costs of overcoming the "adaptation deficit", and actual adaptation costs to climate change. Boundaries between impacts and adaptation are also unclear [e.g. treatment of climate sensitive diseases].

2. NATIONAL (MULTI-SECTORAL) ESTIMATES

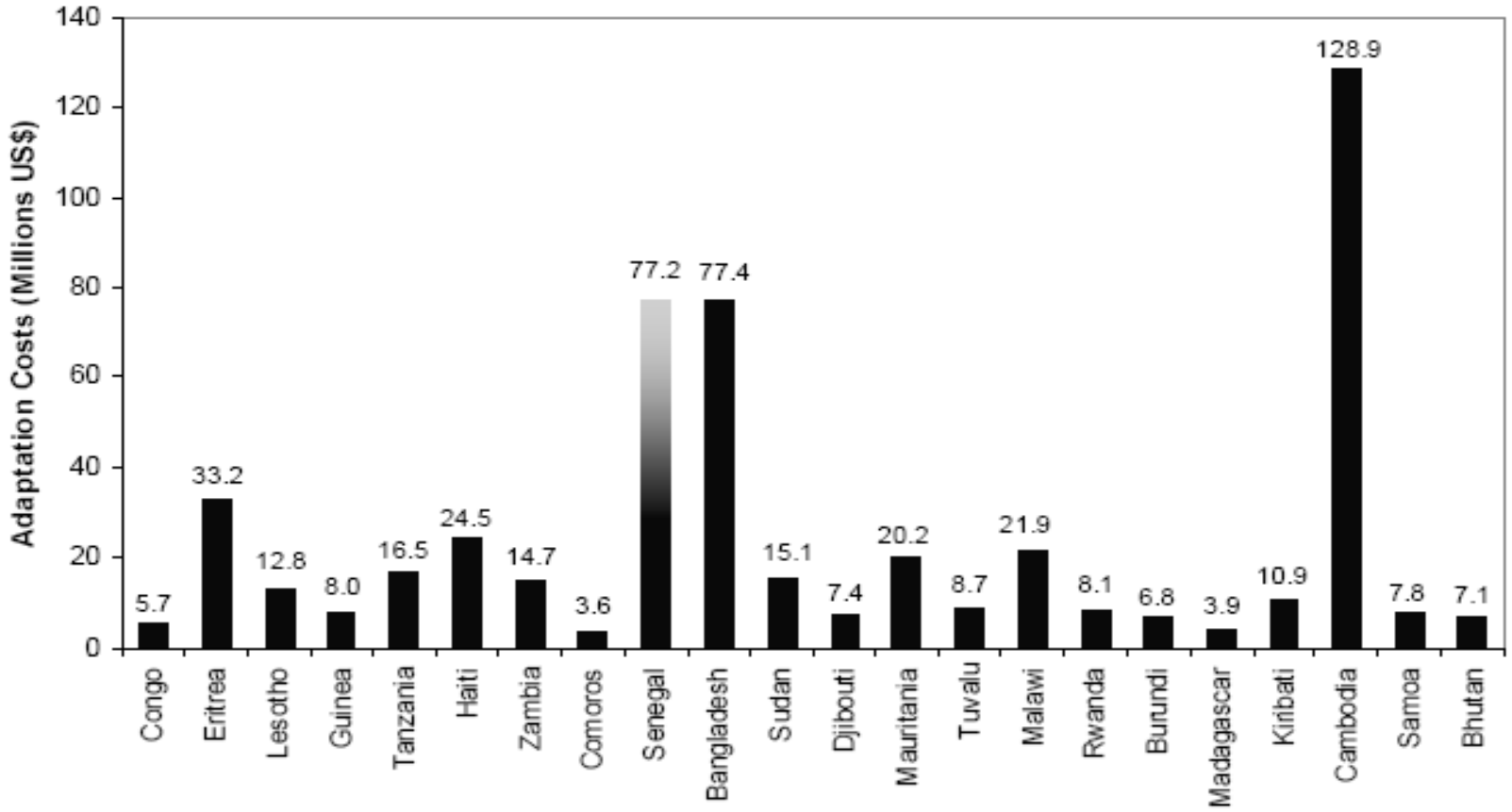
- National Estimates relatively recent – priority adaptations costed for Least Developed Countries as part of the National Adaptation Programmes of Action (NAPAs)

- Stakeholder driven processes [more realistic ?]

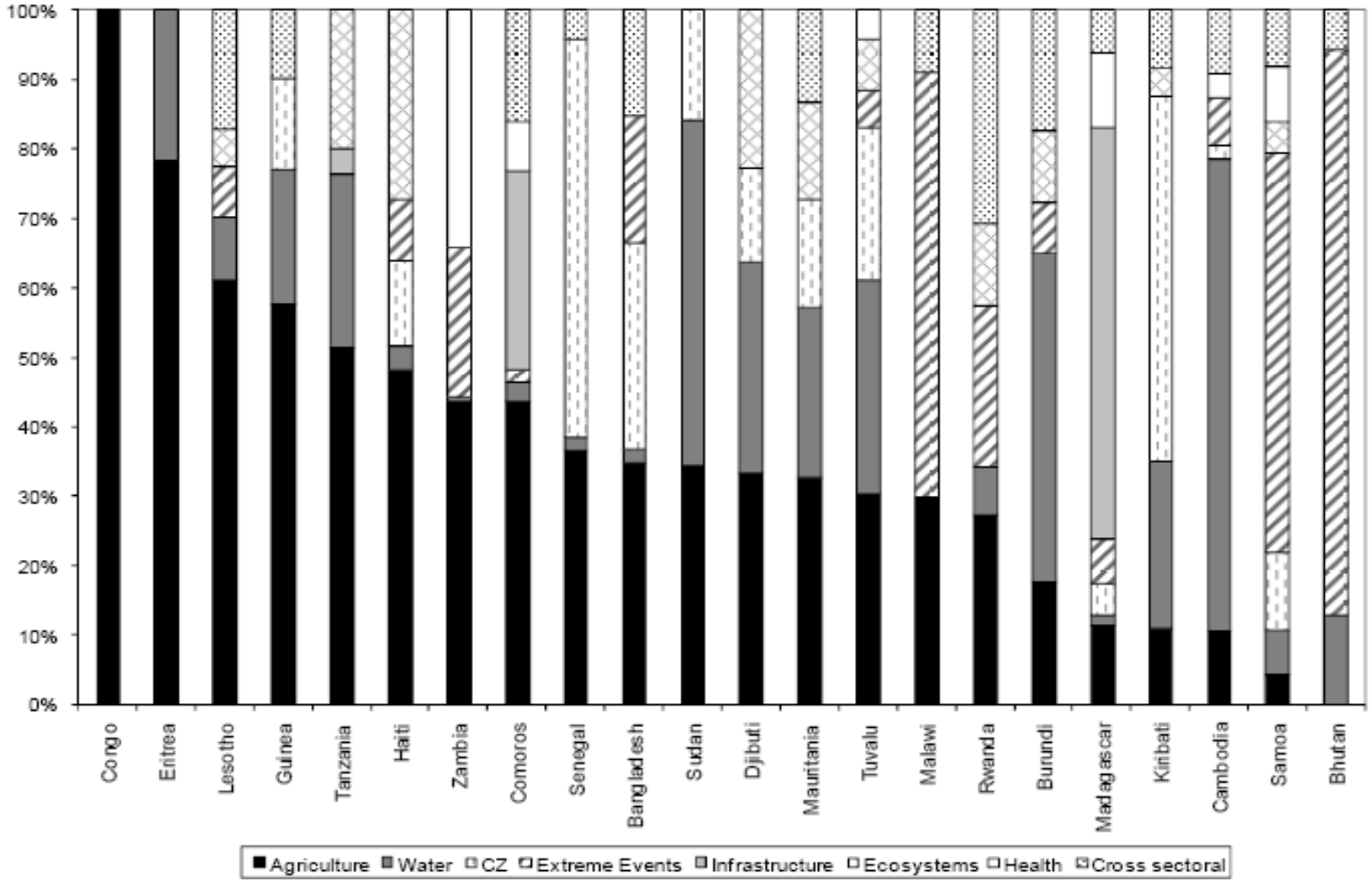
- Reveal many "atypical" adaptations, missed in theoretical studies

- Selection of priority projects, costing, and intended benefits of adaptation measures often not well documented.

2.1 Total Costs of Priority Adaptations in NAPAs



2.2 NAPAs: Sectoral Distribution of Adaptation Costs



3. Global Estimates

- Rapidly emerging area of policy interest – five empirical estimates of adaptation costs between Spring 2006 and fall 2007

- However, only two quasi independent estimates: one by the World Bank as part of its Investment Framework for Clean Energy and Development, and the other by the UNFCCC as part of its study of Investment and Financial Flows.

- Successive studies have tended to stack upon assumptions and estimates of preceding studies, and are not truly independent.

3. Global Estimates

Assessment	"Cost of Adaptation"	Time Frame	Countries Included	Sectors	Comments on methods/sources
World Bank (2006)	**$ 9 – 41 billion/yr**	**Present**	**developing countries**	*unspecified* (presumably all sectors where ODA, FDI, and GDI are directed)	Estimate based on OECD and WB analyses of official flows exposed to climate risk. Costs of "climate proofing" are assumed in the analysis.
Stern Review (2006)	**$ 4 – 37 billion/yr**	**Present**	**developing countries**	*unspecified* (presumably all sectors where ODA, FDI, and GDI are directed)	Update, with slight modifications, of WB study.
Oxfam (2007)	***At least* $50 billion/yr**	**Present**	**developing countries**	*unspecified* (presumably all sectors where ODA, FDI, GDI, and NGO interventions are directed)	WB study, plus extrapolation of cost estimates from NAPAs and NGO projects.
UNDP (2007)	**$86 – 109 billion/yr**	**2015**	**developing countries**	*unspecified* (presumably all sectors where ODA, FDI, and GDI are directed)	WB study, plus costing of targets for adapting poverty reduction programmes and strengthening disaster response systems
UNFCCC (2007)	**$28 – 67 billion/ yr**	**2030**	**developing countries**	Agriculture, forestry and fisheries; water supply; human health; coastal zones; infrastructure	In-depth costing of specific adaptations in water, health and coastal zones. Less detailed costing for agriculture, infrastructure, and ecosystems.
UNFCCC (2007)	**$44 – 166 billion/yr**	**2030**	**global**	Agriculture, forestry and fisheries; water supply; human health; coastal zones; infrastructure	Infrastructure more abstract. Infrastructure adaptation costs overlap with costing in coastal zones and water resources.

3. Global Estimates

- Two core assumptions in such cost estimates: (i) % of assets/investments exposed to climate change risk; and (ii) % incremental cost of "climate-proofing" such investments

- There is very limited (or no) underlying knowledge on both these parameters.

- Cost estimates are extremely sensitive to the assumptions made about these parameters, given the large magnitude of baseline flows they are applied to. Even slight change in assumptions can change results by billions of dollars.

- The "consensus", even in order of magnitude terms of global adaptation costs maybe premature.

4. Some Concluding Remarks

- Adaptation remains a nebulous concept, whose boundaries are not clearly defined. What does, or does not, fall within the purview of adaptation could significantly affect cost estimates. On the benefits side, meanwhile, there are no clear metrics to evaluate progress.

- Adaptation responses are also embedded within responses to a broad range of stimuli; it might not be feasible to cost the climate specific component

- Cost estimates are extremely sensitive to the range of impacts as well as the range of adaptation measures considered. Focus on mean climatic changes can under-estimate costs. On the other hand, focus on “hard "infrastructural adaptations (as opposed to behavioural/institutional measures) can over-state costs and skew responses.

- Costs are also sensitive to the uncertainty associated with climate impacts and timing of adaptation responses, which have not been well examined